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## Summer Occurrence of the Indiana Bat, Keen's Myotis, Evening Bat, Silver-haired Bat and Eastern Pipistrelle in Iowa

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The summer status of the endangered bat *Myotis sodalis* was assessed in Iowa from 1980-1983. Bats were mist-netted at 35 sites in 16 counties and we captured 1199 individuals representing 9 species. In southern counties, a total of 67 *M. sodalis* was captured, including 39 reproductive females, 14 nonreproductive females, 12 juveniles, and 2 adult males. *Myotis keenii* was found throughout the state, but *Nycticeius humeralis* was most abundant in southern Iowa. *Lasiomyotis noctivagans* was caught as far south as the bottom tier of Iowa counties, and *Pipistrellus subflavus* was less abundant in central and western Iowa than anticipated.

INDEX DESCRIPTORS: Iowa, bats, endangered species, threatened species, Indiana bat, *Myotis sodalis*, Keen's myotis, *Myotis keenii*, evening bat, *Nycticeius humeralis*, silver-haired bat, *Lasiomyotis noctivagans*, eastern pipistrelle, *Pipistrellus subflavus*.

Except for studies by Kunz (1971, 1973), little has been published on the natural history of bats in Iowa. This report provides new information on 5 species, acquired in 1980-1983. Our study focused primarily on the summer status and distribution of the federally endangered Indiana bat, *Myotis sodalis* (Miller and Allen), Iowa's threatened evening bat, *Nycticeius humeralis* (Rafinesque), and Keen's myotis, *Myotis keenii* (Merriam). We also include data on the silver-haired bat, *Lasiomyotis noctivagans* (Le Conte), and eastern pipistrelle, *Pipistrellus subflavus* (F. Cuvier).

### METHODS

We sampled bat populations at 35 locations in 16 Iowa counties (Table 1, Fig. 1) during the summers of 1980-1983. Sampling sites included disturbed and undisturbed upland, riparian, and floodplain deciduous woodlands, which were selected because of the potential for *M. sodalis* nursery sites (i.e., mature trees with exfoliated bark or cavities and/or dead trees). Mist nets of 1-3 tiers (5.5-12.8-m wide) were placed perpendicular to flyways (trails, streams, forest openings, and roads), as well as at entrances of 2 abandoned coal mines and a cave. A harp trap (Tuttle 1974) was used at Becker's South Quarry Cave.

When possible, we sampled each site at least twice for 3 consecutive nights between mid-June and early August. Nets were usually open from sunset to sunrise. We recorded sex, weight, age, reproductive condition, and lengths of the forearm, third and fifth metacarpals of each bat captured. U.S. Fish and Wildlife Service aluminum bands were placed on the left forearm of females and right forearm of males; however, we used plastic rings (A.C. Hughes, London) for *M. keenii* and barely volant juveniles. We also banded *M. sodalis* with red, white, and blue striped plastic rings on the wing opposite the aluminum band to facilitate species identification in hibernacula. All bats were released at the capture sites, except 8 individuals that were injured during handling and subsequently deposited in the MacBride Museum, University of Iowa.

### RESULTS AND DISCUSSION

We captured 1199 bats of 9 species during 138 nights of sampling including 108 *M. keenii*, 67 *M. sodalis*, 63 *L. noctivagans*, 42 *N. humeralis* and 11 *P. subflavus* (Table 2). Our study did not provide new information on the other four bats common to Iowa: the big brown bat, *Eptesicus fuscus* (Palisot de Beauvois); little brown bat, *Myotis*

*lucifugus* (Le Conte); red bat, *Lasiurus borealis* (Müller); and hoary bat, *Lasiurus cinereus* (Palisot de Beauvois).

#### *Myotis keenii*.

This bat was listed as a threatened species in Iowa (Roosa 1977). Both males and females have been reported from throughout the state in summer (Bowles 1975). Prusko and Bowles (1986) summarized cave use by *M. keenii* in Iowa during winter.

We captured this species throughout much of the state, including Stone State Park, Woodbury County (Table 2, Fig. 1), the approximate western range limit. Of 27 adult females examined, 19 were either pregnant or had large/lactating mammae. Pregnancy was noted through 9 July, somewhat later than reported by Kunz (1971), and lactation was last observed on 23 July. On 2-3 July 1980, we netted 5 *M. keenii* (1 pregnant female, 1 lactating female, and 3 volant young) as they emerged from under loose bark (ca. 8 m above the ground) of a 50-cm dbh dead elm (*Ulmus* sp.) in Chariton Unit of Stephen's State Forest, Lucas County. When we returned to the site on 5 August 1980, no bats emerged, and by 16 June 1981, the tree had been removed for fire wood.

A total of 8 juvenile males and 13 juvenile females was netted. We caught the first volant young on 2 July, 21 days earlier than reported for Iowa by Kunz (1971). Although we found adult males and adult females or volant young at 11 of the 27 locations where *M. keenii* were taken, both sexes were netted together on only 7 of the sampling periods. This is consistent with the comment by Fitch and Shump (1979) that females generally form maternity colonies separate from male colonies. Interestingly, males ( $n=57$ ) outnumbered females ( $n=27$ ), the reverse of Kunz's (1971) study. Of the 57 adult males, 25 were from northeastern counties (Allamakee, Delaware, Dubuque, Jones, and Winneshiek). Fourteen of 17 males with descended testes also were found in these counties. Thus, reproductively active males probably stay in the vicinity of caves and mines along the Mississippi River.

#### *Myotis sodalis*.

Prior to 1975, *M. sodalis* was known only from fall and winter records in east-central Iowa (Bowles 1975). Three males banded in central Missouri have been recovered in Jasper (Myers 1964), Louisa (Myers, pers. comm.), and Lucas (Bowles, unpubl. data) counties, and provide evidence that males are present in southern Iowa during summer and fall, although they are less numerous than females. Subsequently, Bowles captured 2 pregnant, 2 lactating, and 2 nonreproductive females and 3 juveniles in Marion County, Iowa,

Table 1. Legal descriptions of 35 Iowa study sites sampled for bats during the summers of 1980-1983.

County and Site	Legal Description
<b>ALLAMAKEE COUNTY</b>	
1. French Creek	NE ¼ sec 23, T-99N, R-05W
2. Yellow River Road	SE ¼ sec 33, T-96N, R-03W
<b>APPANOOSE COUNTY</b>	
3. Clark Mine	NE ¼ sec 26, T-69N, R-19W
4. G.D. Fenton Property	SE ¼ sec 29, T-69N, R-18W
5. Louie Heck Mine	SW ¼ sec 19, T-69N, R-18W
6. Rathbun Lake, Moffit Ridge	SE ¼ sec 25, T-70N, R-18W
<b>BOONE COUNTY</b>	
7. Ledges State Park, Pease Creek	NW ¼ sec 21, T-83N, R-26W
<b>CLAYTON COUNTY</b>	
8. Bloody Run County Park	SE ¼ sec 17, T-95N, R-03W
9. Osborne Conservation Education Center	SW ¼ sec 09, T-92N, R-05W
10. Sny Magill, North Cedar Creek Unit	SE ¼ sec 08, T-94N, R-03W
11. Sny Magill, Effigy Unit	NW ¼ sec 23, T-94N, R-03W
<b>DECATUR COUNTY</b>	
12. Sand Creek Wildlife Area	NW ¼ sec 18, T-70N, R-27W
13. Sand Creek Wildlife Area, Nichol's Farm	SW ¼ sec 17, T-70N, R-27W
<b>DELAWARE COUNTY</b>	
14. Backbone State Park, Richmond Springs	NE ¼ sec 08, T-90N, R-06W
15. Fountain Springs Creek Park	NE ¼ sec 16, T-90N, R-04W
16. Manchester State Trout Hatchery	SW ¼ sec 02, T-88N, R-05W
<b>DUBUQUE COUNTY</b>	
17. Becker's South Quarry Cave	SW ¼ sec 14, T-89N, R-02E
18. Finley's Landing	NE ¼ sec 35, T-91N, R-01E
19. New Wine County Park	SW ¼ sec 07, T-89N, R-02W
20. Swiss Valley Nature Preserve	NE ¼ sec 19, T-88N, R-02E
21. White Pine Hollow State Preserve	SW ¼ sec 08, T-90N, R-02W
22. YMCA Camp	SW ¼ sec 10, T-89N, R-02W
<b>HARDIN COUNTY</b>	
23. J.L. Reece Memorial Park	SW ¼ sec 16, T-86N, R-20W
24. Steamboat Rock-Tower Rock Park	SW ¼ sec 28, T-88N, R-29W
<b>JONES COUNTY</b>	
25. Searry's Cave	NW ¼ sec 36, T-86N, R-01W
<b>LUCAS COUNTY</b>	
26. Stephen's State Forest, Cedar Creek Unit	NE ¼ sec 33, T-72N, R-20W
27. Stephen's State Forest, Chariton Unit	NE ¼ sec 25, T-72N, R-20W
<b>MADISON COUNTY</b>	
28. Goeldner Woods	SW ¼ sec 21, T-77N, R-28W
<b>MARION COUNTY</b>	
29. Lake Red Rock, Sadler's Woods	NW ¼ sec 18, T-76N, R-18W
30. Sand Creek	NW ¼ sec 01, T-75N, R-18W
<b>MARSHALL COUNTY</b>	
31. L.F. Mills' Property	NE ¼ sec 36, T-84N, R-17W

**VAN BUREN COUNTY**

32. Lacey-Keosauqua

State Park

SE ¼ sec 03, T-68N, R-10W

**WINNESHIEK COUNTY**

33. Bear Creek, Confluence

SE ¼ sec 25, T-100N, R-7W

34. South Bear Creek

NE ¼ sec 33, T-100N, R-7W

**WOODBURY COUNTY**

35. Stone State Park,

Coon Hollow

NE ¼ sec 01, T-89N, R-48W

including a pregnant female recovered in late June 1979 which had been banded 2 months earlier at Pilot Knob Mine, Iron County, Missouri (LaVal and LaVal 1980). Only 2 females and 3 males have been reported in hibernation in Iowa; however, the species probably rarely over-winters here (Clark et al., in press, Pruszek and Bowles 1986).

Although we netted bats at sites throughout eastern and south-central Iowa, this species was found only in southern counties (Table 2, Fig. 1). Of 53 adult females examined, 12 were pregnant, 25 were lactating and 2 were postlactating. Pregnancy was noted through 8 July and lactation was discernible until 22 July. The first of 12 (5 m : 7 f) juveniles was captured on 7 July. We also captured 2 adult males, 1 on 6 June 1980 at Sand Creek, Marion County, and the other on 3 July 1980 at Chariton Unit of Stephen's State Forest, Lucas County.

*Lasiomys noctivagans*.

This species is not considered threatened or endangered in Iowa; however, very little is known of its summer ecology. Easterla and Watkins (1970) and Kunz (1971) found reproductively active female and juvenile *L. noctivagans* in the state, but males have been reported only during migration (Kunz 1971).

Although we captured this species at 10 sites in 8 counties (Table 2), the largest number of individuals ( $n = 29$ ) was taken at Sand Creek Wildlife Area, Decatur County, the southernmost summer locality on record for Iowa. Adult females and volant young were found there during 8-10 July and 12-13 August 1980, but had apparently left the area by 20 September. Both adult females and volant young were netted there again during 30 June - 2 July 1981, and on 30 June 1982 when we caught 2 lactating females. None of the 17 adult females were pregnant, although 8 were lactating and 1 had large mammae. The first of 43 volant young was captured on 28 June. Juvenile females outnumbered juvenile males 33 to 10; however, Kunz (1971) found no difference in the sex ratio of juveniles (12 m : 13 f). A young, volant male captured on 27 July had descended testes. In 1980, we captured 2 non-breeding adult males (testes not descended); the first on 3 July and the other on 6 August at Cedar Creek Unit and Chariton Unit, respectively, of Stephen's State Park, Lucas County. These are the only summer records of adult males reported in Iowa.

*Nycticeius humeralis*.

This species was placed on the initial Iowa threatened species list (Roosa 1977). Free-flying female and juvenile *N. humeralis* were reported from several counties in southern Iowa (Kunz and Schlitter 1968, Schlitter and Bowles 1968, Easterla and Watkins 1970), and maternity colonies were found in attics of buildings in Page and Taylor counties (Watkins 1969). No adult males have been reported from Iowa.

We found *N. humeralis* throughout most of southern and central Iowa (Table 2, Fig. 1). The northernmost record for the state was a pregnant female we netted at Stone State Park, Woodbury County, on 31 May 1981. Sixteen of 21 adult females captured were pregnant or lactating. The latest pregnancy date was 7 July and that for lactation was 16 July. Numbers of young males ( $n = 10$ ) and females ( $n = 11$ ) were nearly equal. Seven of the young males had descended testes, including 1 taken on 7 July.

Table 2. Number of bats captured by species and net effort for each of the 35 study sites sampled during summers of 1980-1983.

County and Site <sup>a</sup>	EPFU	MYLU	LABO	MYKE	Species <sup>b</sup> MYSO	LANO	NYHU	LACI	PISU	TOTAL	Linear-meter- net-hours
ALLAMAKEE											
1.	-	20	2	3	-	1	-	1	1	28	697
2.	-	10	-	1	-	-	-	-	-	11	492
APPANOOSE											
3.	-	-	-	-	-	-	-	-	-	0	17
4.	8	1	1	3	12	2	-	1	-	28	6124
5.	-	-	-	5	-	-	-	-	-	5	37
6.	-	-	-	-	-	-	-	-	-	0	494
BOONE											
7.	41	-	9	1	-	3	-	1	-	55	375
CLAYTON											
8.	-	6	-	-	-	-	-	-	-	6	619
9.	-	4	-	-	-	-	-	-	-	4	1107
10.	-	15	1	-	-	-	-	-	-	16	765
11.	1	7	-	1	-	-	-	-	-	9	819
DECATUR											
12.	42	6	42	13	17	28	11	20	-	179	8677
13.	4	-	2	-	2	1	1	1	-	11	535
DELAWARE											
14.	6	10	5	5	-	-	-	1	1	28	1339
15.	2	5	4	7	-	-	-	1	-	19	2277
16.	16	76	-	-	-	-	-	1	1	94	1819
DUBUQUE											
17.	1	3	-	1	-	-	-	-	-	5	- <sup>c</sup>
18.	1	12	-	-	-	-	-	1	-	14	766
19.	18	38	3	6	-	-	-	1	1	67	1228
20.	-	-	-	3	-	-	-	-	-	3	730
21.	10	8	2	2	-	-	-	-	1	23	1204
22.	9	66	3	5	-	-	-	2	-	85	1224
HARDIN											
23.	21	25	1	4	-	-	-	1	2	54	1287
24.	12	3	6	1	-	-	-	-	-	22	2626
JONES											
25.	5	2	-	2	-	-	-	-	-	9	60
LUCAS											
26.	10	1	14	4	5	3	4	3	-	44	2670
27.	11	-	8	9	10	5	1	-	-	44	7397
MADISON											
28.	73	-	-	11	12	14	13	1	-	124	2284
MARION											
29.	20	-	2	2	1	5	1	-	-	31	1633
30.	27	2	31	3	3	-	8	3	1	78	7053
MARSHALL											
31.	1	1	-	1	-	-	-	-	-	3	2569
VAN BUREN											
32.	15	-	20	4	5	1	2	2	3	52	2780
WINNESHIEK											
33.	-	1	4	1	-	-	-	1	-	7	916
34.	2	17	-	2	-	-	-	-	-	21	684
WOODBURY											
35.	6	-	5	8	-	-	1	-	-	20	1812
TOTAL	362	339	165	108	67	63	42	42	11	1199	65116

<sup>a</sup>See Table 1 for study site names and legal descriptions.<sup>b</sup>Species of bats: EPFU = *Eptesicus fuscus*, MYLU = *Myotis lucifugus*, LABO = *Lasiurus borealis*, MYKE = *Myotis keenii*, MYSO = *Myotis sodalis*, LANO = *Lasionycteris noctivagans*, NYHU = *Nycticeius humeralis*, LACI = *Lasiurus cinereus*, PISU = *Pipistrellus subflavus*.<sup>c</sup>2.5 harp-trap-hours.

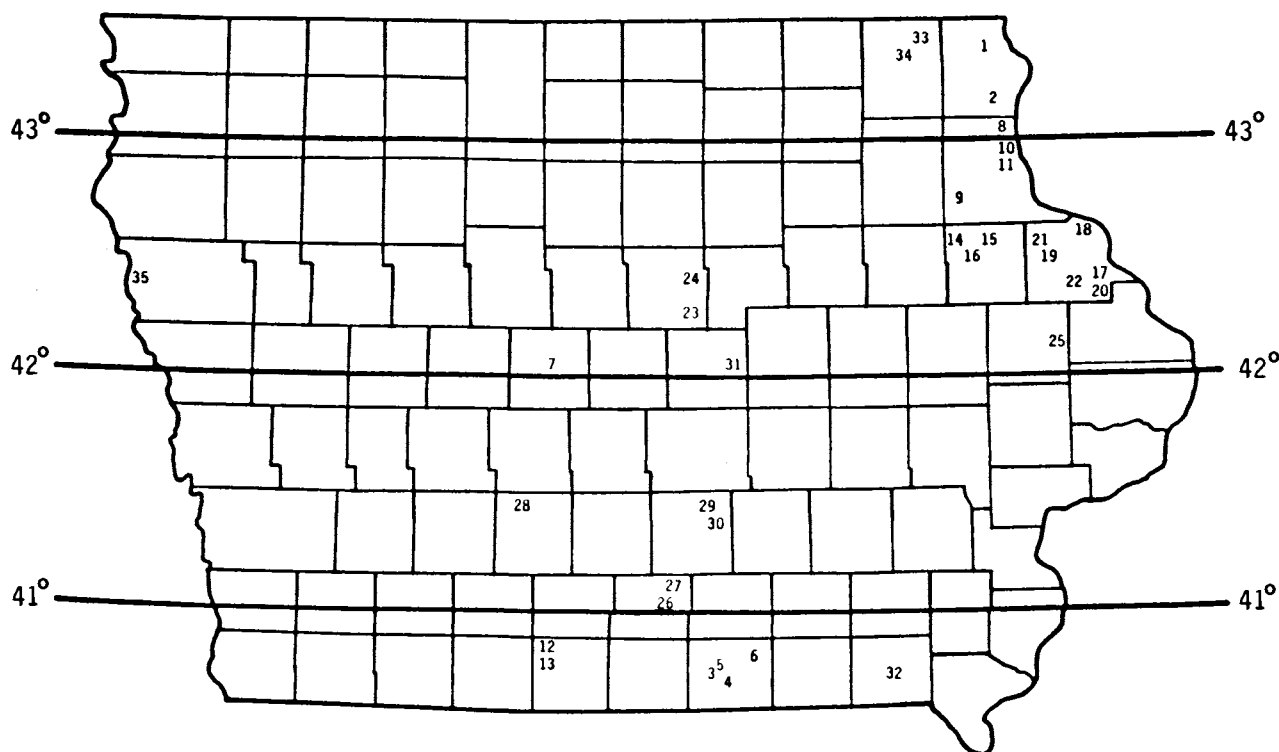


Figure 1. Approximate location of the 35 study sites (numbers correspond with locations in Table 1) sampled in 16 counties.

#### *Pipistrellus subflavus*.

This was the least abundant species of our study (Table 2) and may be common only in the eastern 1/3 of the state where it also overwinters. Muir and Polder (1960) and Kunz and Schlitter (1968) found *P. subflavus* throughout the year in caves of eastern Iowa, and Pruszko and Bowles (1986) found this species in 9 of 19 caves during winter 1983-1984.

Two of the 3 adult females we netted were reproductively active. A pregnant female was captured at Manchester State Trout Hatchery, Delaware County, on 24 June 1982 and a lactating female was netted on 15 July 1980 at Lacey-Keosauqua State Park, Van Buren County. We caught the first of 4 volant young (2 m : 2 f) on 15 July. Single, non-reproductive adult males were taken during our study at Backbone State Park, Delaware County, and White Pine Hollow State Preserve, Dubuque County. We also netted an adult male with descended testes at New Wine County Park, Dubuque County.

#### COMMENTS

The statewide distribution and relative abundance of both male and female *M. keenii* support Kunz's (1971) observation that this species is a common summer resident. Maternity roosts evidently are present in wooded areas throughout much, if not all, of Iowa. As a result of this study, *M. keenii* was removed from the Iowa revised threatened species list (Iowa Administrative Code 1986).

*M. sodalis* probably reaches its northwestern range limit in Iowa at approximately 42°N latitude. Although habitat availability and competition may be important determinants of local distribution, we believe that regional presence is more likely influenced by climatic factors. Latitudinal variation in temperature may be sufficient to affect nursery roost microclimate and embryonic and juvenile growth rates, thereby limiting both *M. sodalis* and *N. humeralis* to southern Iowa. We found May-Cooling-Degree-Days (Cooling-Degree-Days = Sum

of average upward daily departure from 65°F) to have the highest correlation with the presence of the Indiana bat in a step-wise discriminant analysis (Clark et al., in press).

The abundance of female and volant young *L. noctivagans* in Decatur County is evidence that southern Iowa is well within maximal summer range for reproductive females. Our records, those of Kunz (1971) for Boone County, and the presence of a volant juvenile from Brushy Creek Recreation Area, Webster County (Bowles, unpubl. data), indicate a statewide summer distribution of females. Most adult males apparently spend this season farther north, although some do stay in the state during summer.

Summer records for *P. subflavus* have been few and widely scattered throughout the state, except for those in caves near the Mississippi River. This species approaches its western range limit in Iowa, and the lack of suitable hibernacula in western Iowa may limit its distribution in the state.

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